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"Study of Weak Solar Magnetic Fields"

Harold Zirin
Principal Investigator

California Institute of Technology
1201 E. California Blvd.
Pasadena, CA 91125

Study of Weak Solar Magnetic Fields

This is a final report on our grant N00014-88-K-0089, Study of Weak Solar Magnetic Fields. This grant expired on November 30, 1988.

This program was a major activity of the Big Bear Solar Observatory during that year, although because the amount of this grant was small, most of the activity was supported by grants from NASA and the NSF. However, the contribution was welcome. In this period, we made further strides in the application of the magnetograph to the study of weak magnetic fields. A number of excellent runs were obtained. A presentation of results was made by me at the Solar Cycle Workshop in Sydney, Australia in January 1989. In addition, a number of papers have been published on this subject by members of our group, of which a small fraction is attributable to the support of this contract. We enclose preprints of two papers recently completed and submitted for publication in *Solar Physics* by Haimin Wang, "On the Relationship Between Magnetic Fields and Supergranule Velocity Fields" and "Do Mesogranules Exist?".

There have been two major gains in our work in this period: First, the completion and analysis of round-the-clock observations in cooperation with the Huairou Observatory in the People's Republic of China, which enabled us to obtain the first long-term observations of weak solar magnetic fields, and the application of the magneto-optic filter to the measurement of magnetic fields, in collaboration with Professor Alessandro Cacciani of the University of Rome. The observations in collaboration with China have enabled us to make observations for as long as seven days of solar magnetic regions, with only short interruptions when the sun could not be seen from the U.S. and China. The major result of this work is that the stronger elements of the chromospheric network are rather long lived, lasting about 70 hours. In fact, it is possible that they last longer, because although the shape changes it is often possible to still identify a magnetic entity. The second important result was that one could find definite evidence of magnetic field cancellation occurring after solar flares. The increased time coverage enabled us to check the evolution of the magnetic fields during this period.

The other development, the use of the magneto-optic filter, is full of promise for the future. This filter is made by using a glass tube filled with potassium which is placed in a strong magnetic field. It enables us to obtain a passband of about 30 milliAngstroms at the potassium resonance line at 7699 Angstroms. This filter ~~has enabled us to~~ take magnetograms of sensitivity higher than ~~we have ever~~ obtained before; the only limitation is on the position of the passband which is fixed until we obtain an electromagnet to vary the magnetic field strength. ~~We believe that~~ the magneto-optic filter will enable us to go much further in the measurement of solar magnetic fields.

Sara Martin has carried out an extensive program of studies of weak magnetic fields, with particular emphasis on the occurrence of cancellation events and on the behavior of ephemeral active regions. In addition, we had one undergraduate student this past summer counting ephemeral regions in the old Big Bear magnetograms. I was able to recognize that there is a problem with the limiting magnitude for ephemeral regions since the fainter you go, the more there are. We will be concentrating on this problem in the future to establish a more quantitative way of measuring the number of ephemeral regions.

Work has already begun on the new grant on the measurement of the poles of the sun, and we shall be concentrating on that problem in the near future.